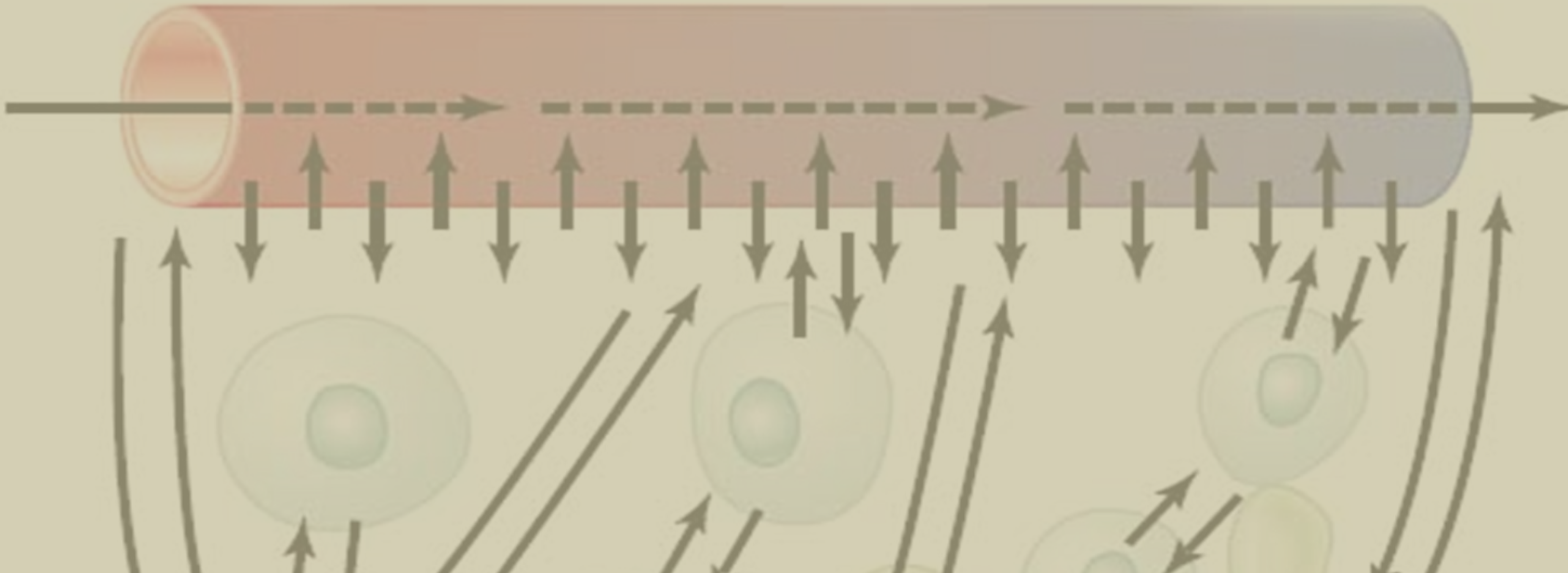
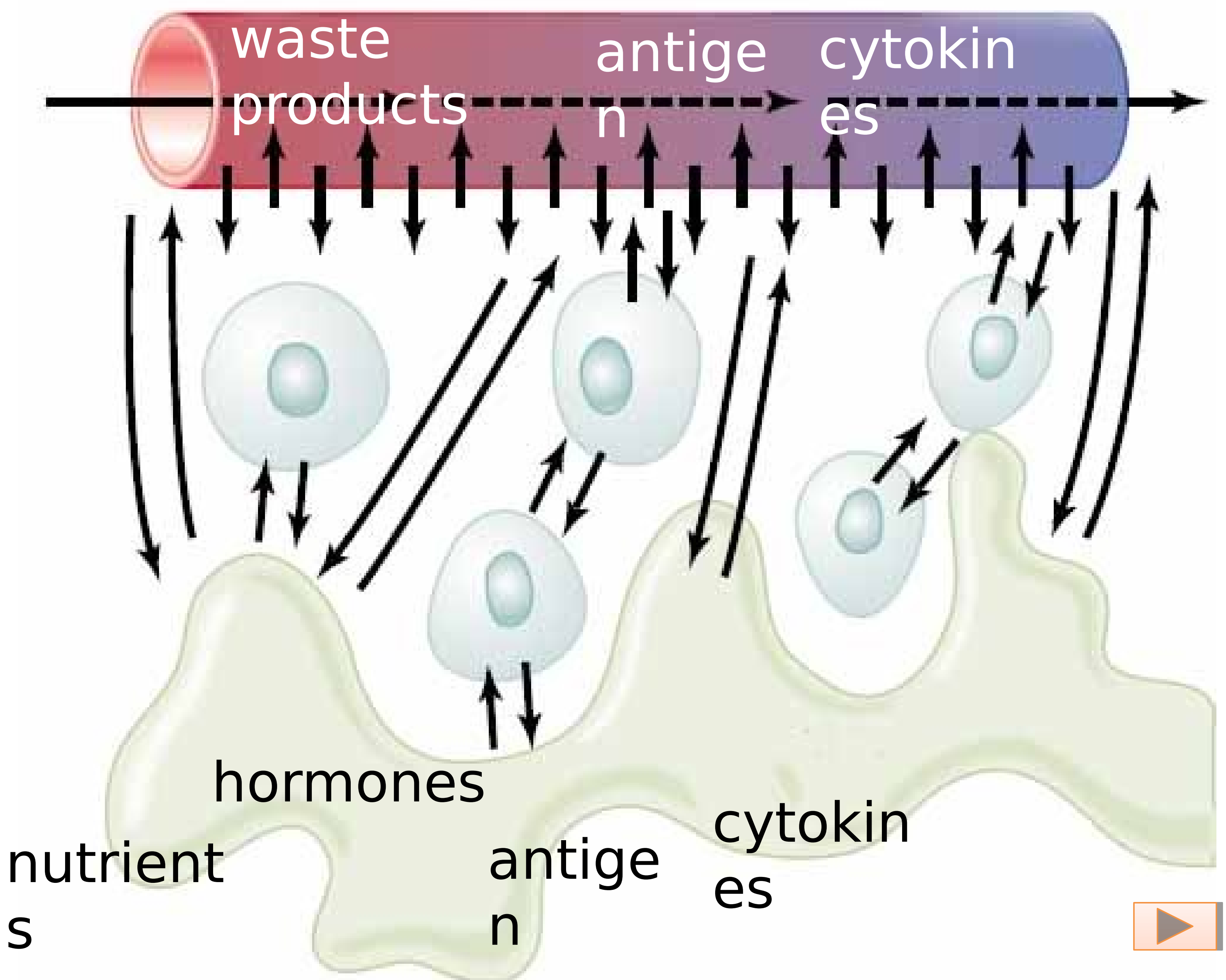


Transcapillary exchange

Interstitial fluid formation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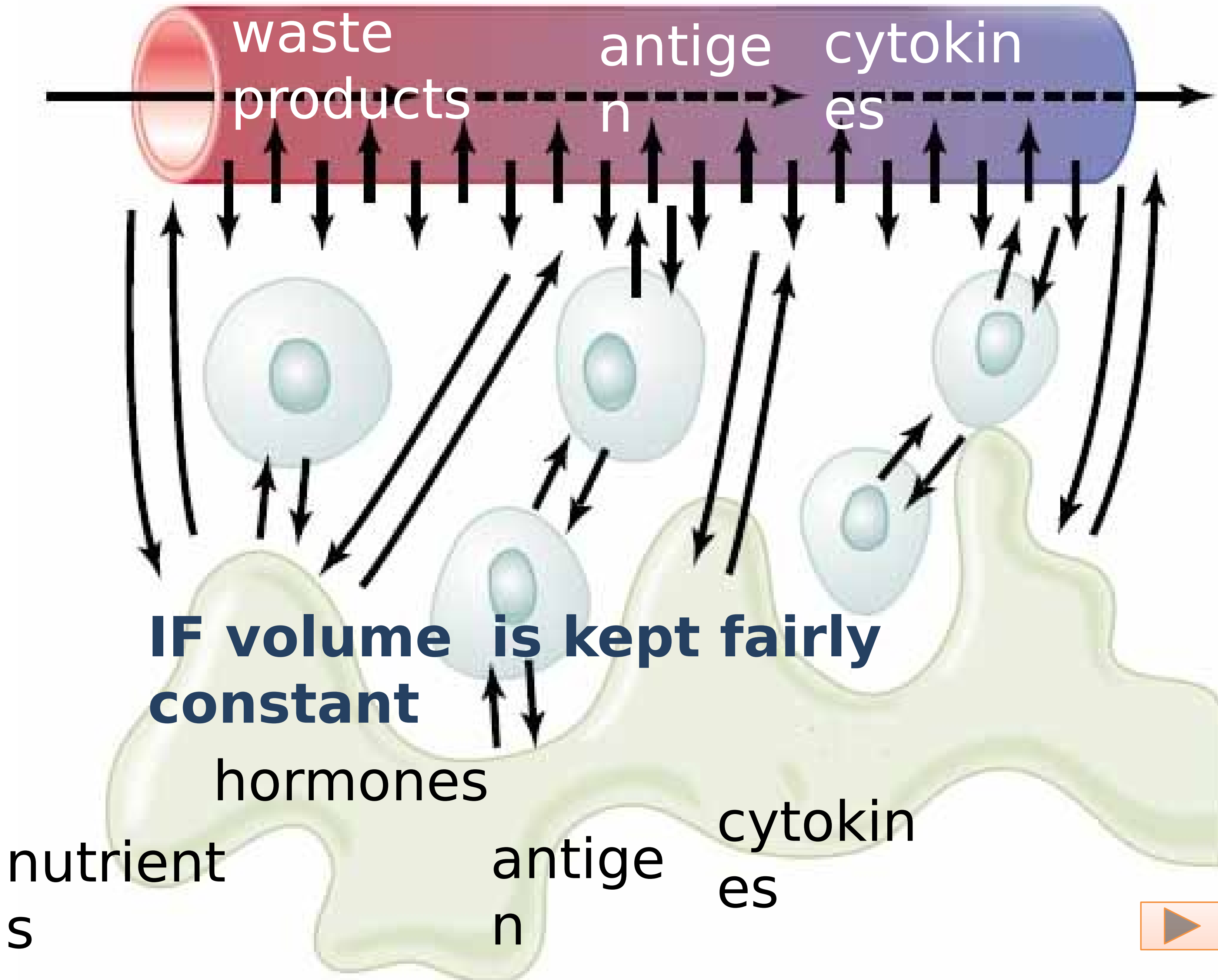


IF volume is kept fairly constant

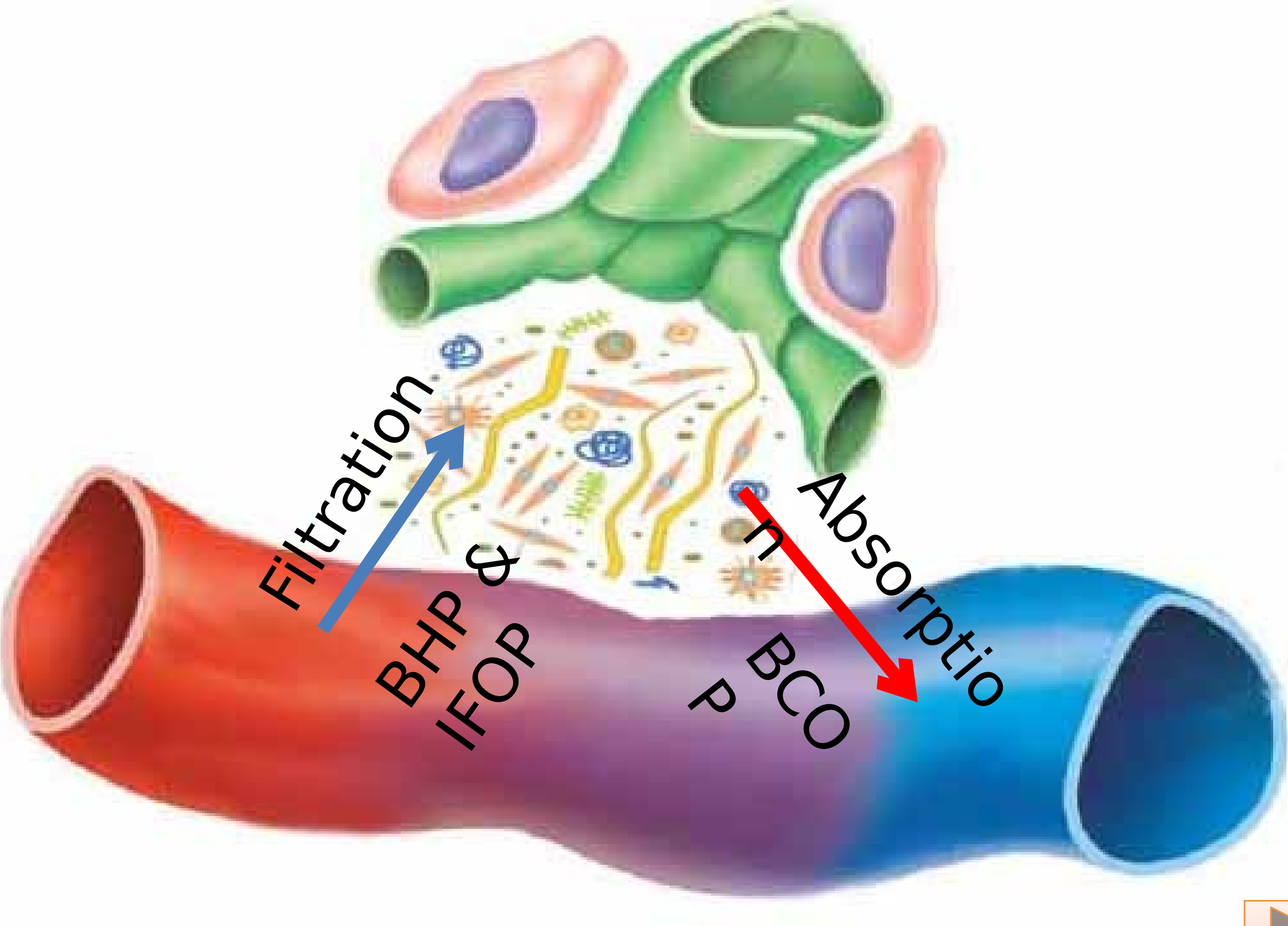
The formation of interstitial fluid and transcapillary exchange is determined by properties of:

- capillary wall
- hydrostatic pressure in capillary and interstitium
- protein concentrations in the blood and interstitium

Basic principles for such transport originated from fundamental work by Starling more than a century ago and are still applies.

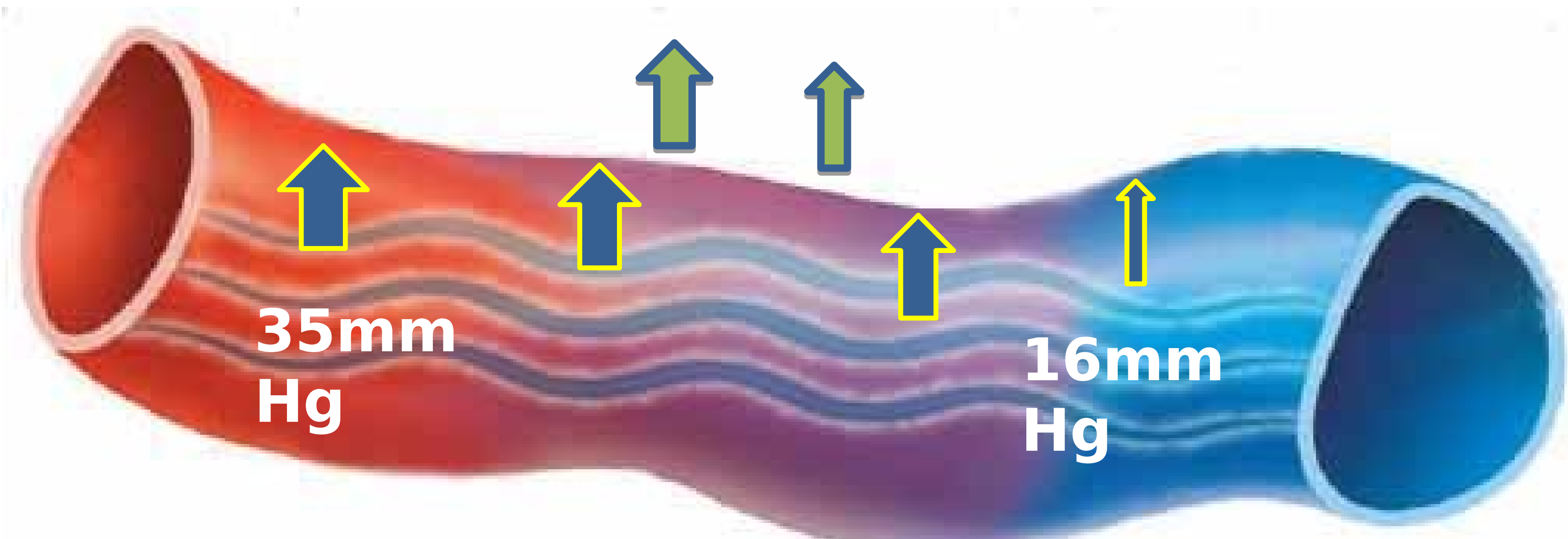
Four of the main forces which determine the fluid flow direction between interstitium and capillaries are

- **The blood hydrostatic pressure (BHP)**
- **interstitial fluid hydrostatic pressure (IFHP)**
- **Blood colloid osmotic pressure (BCOP)**
- **interstitial fluid osmotic pressure (IFOP)**


Filtration
BHP &
IFOP
Absorption
BCOP

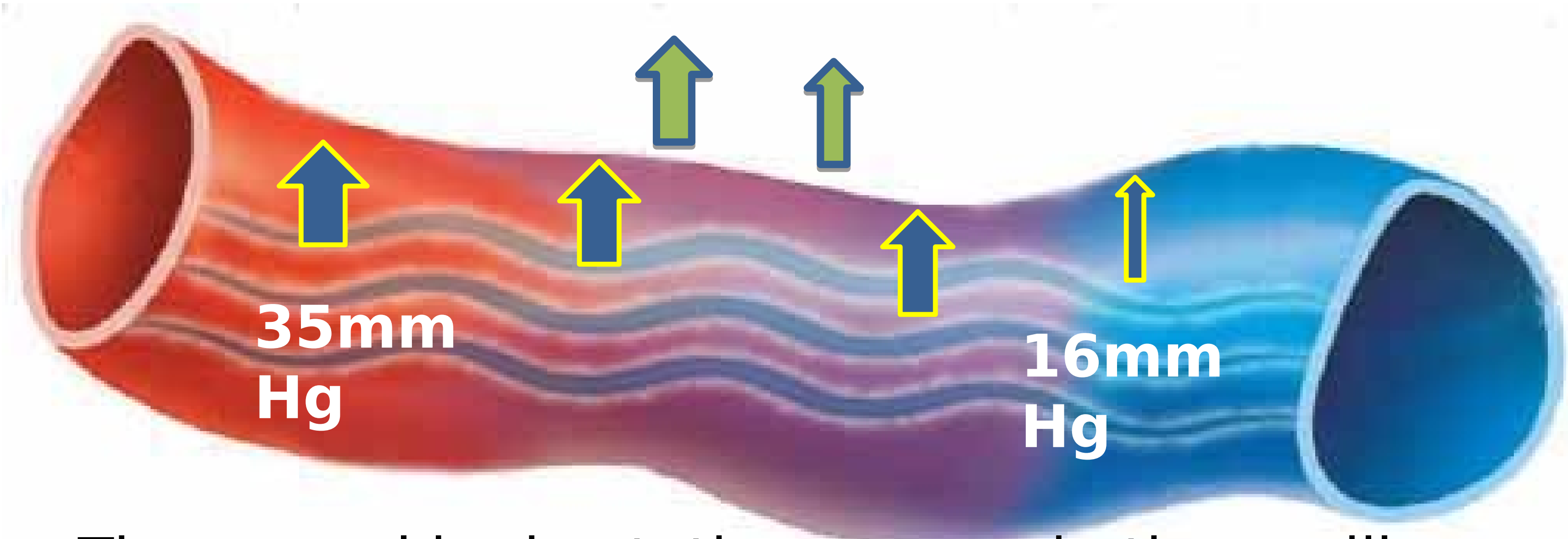
BHP

Within vessels, the hydrostatic pressure is due to the pressure that water in blood plasma exerts against blood vessel walls.



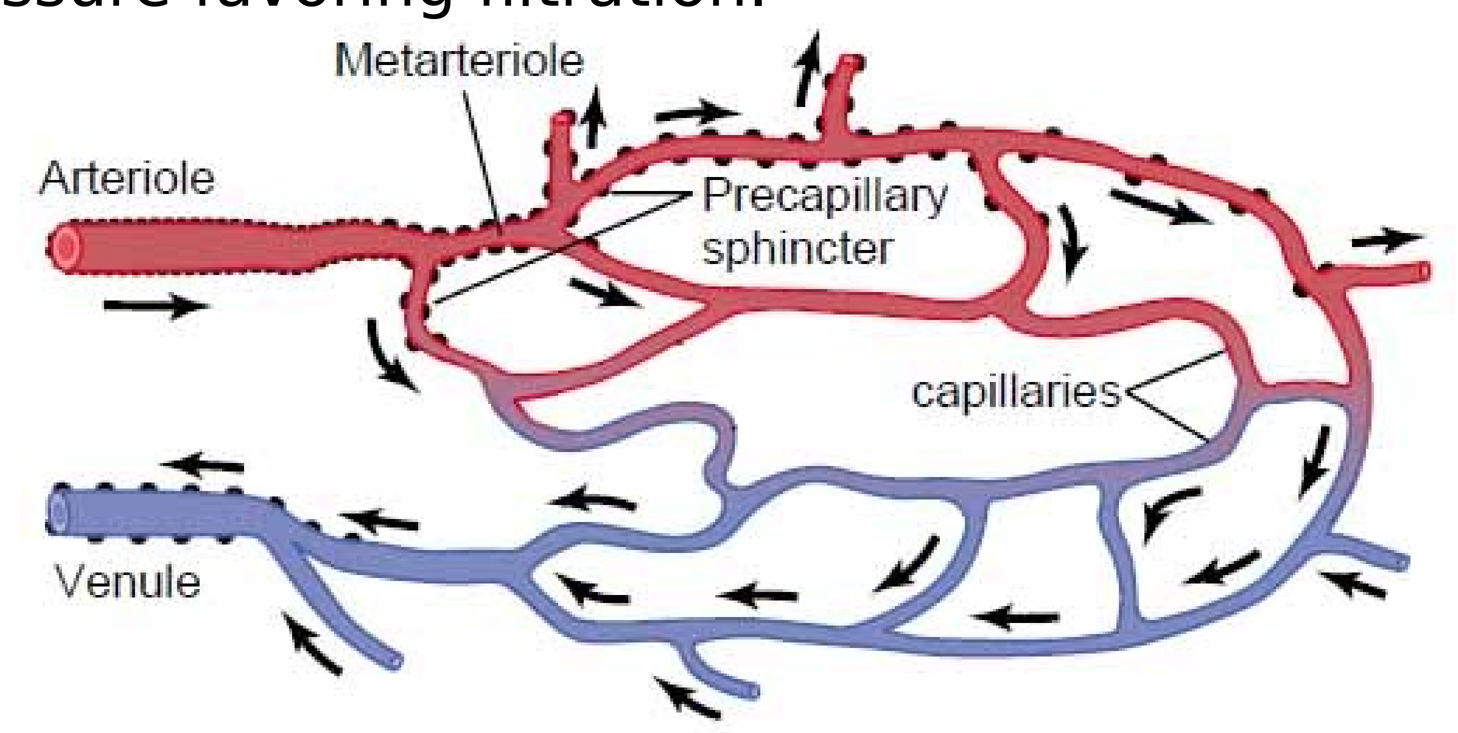
The hydrostatic pressure in the intravascular space is the principle force driving water and electrolytes out of the capillary into the interstitial space.

BHP may vary in different tissues and at different levels within each capillary bed.

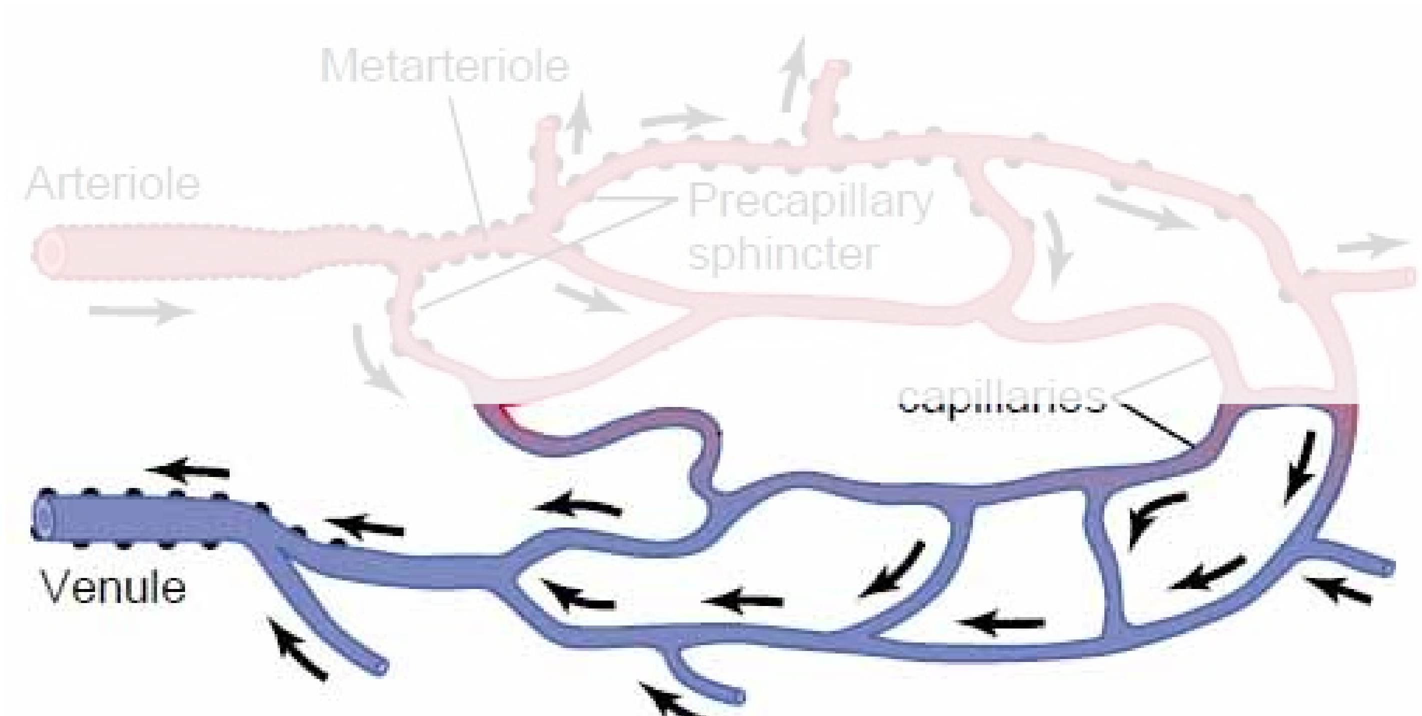


The normal hydrostatic pressure in the capillary bed is controlled by local myogenic, neurogenic, and humoral modulation of the arterial and venous resistances.

An increase in small artery, arteriolar, or venous pressure will increase the capillary hydrostatic pressure favoring filtration.

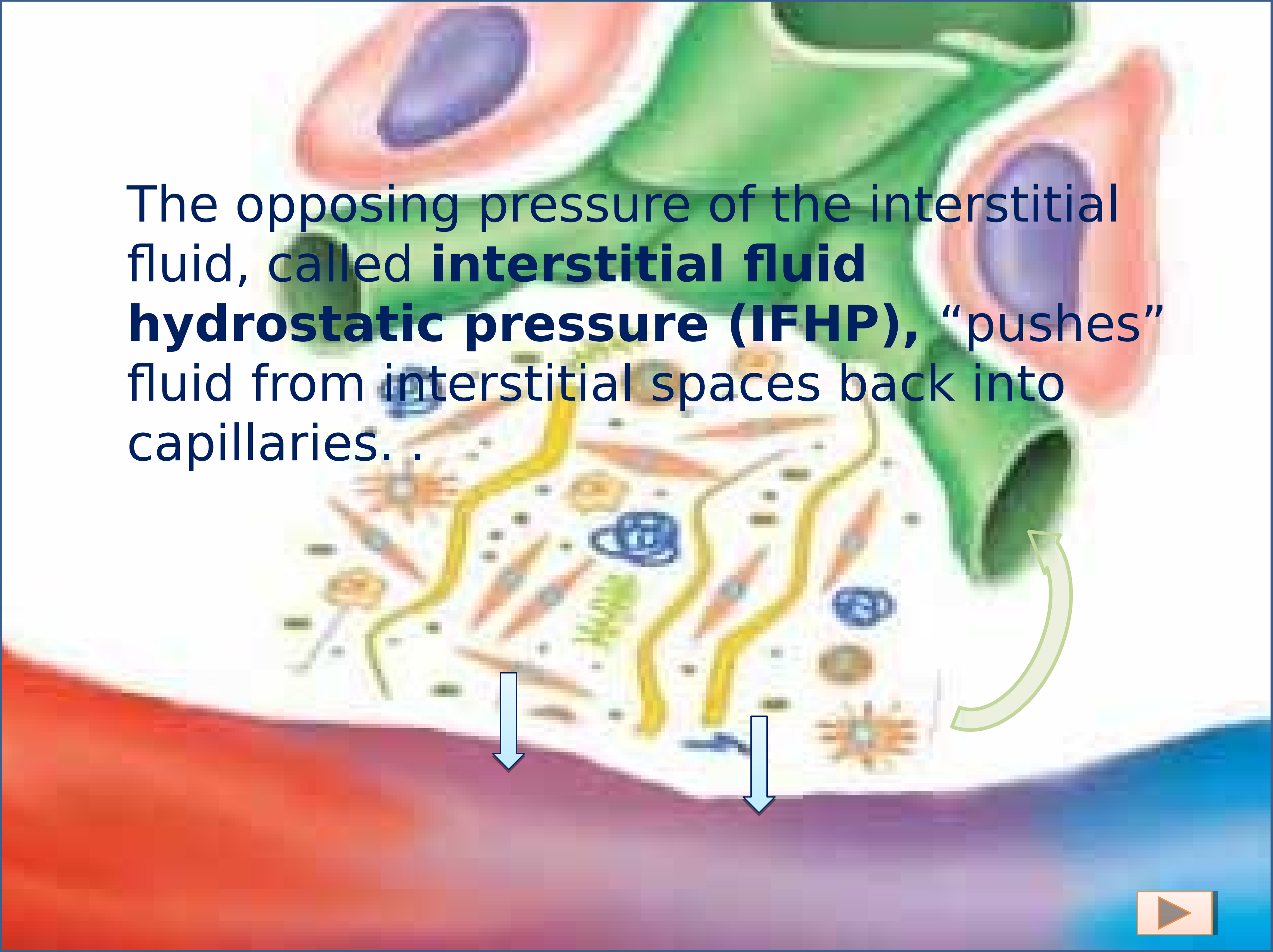


A reduction of these pressures will have the opposite effect.

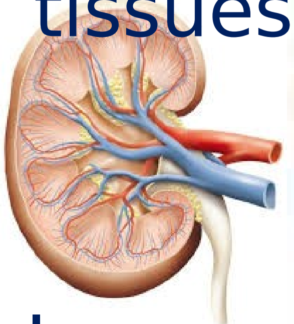


While an increase in the venous resistance results in increased upstream capillary hydrostatic pressure. In general, changes in the venous resistance result in a greater effect on the capillary pressure than chang

The opposing pressure of the interstitial fluid, called **interstitial fluid hydrostatic pressure (IFHP),** “pushes” fluid from interstitial spaces back into capillaries. .

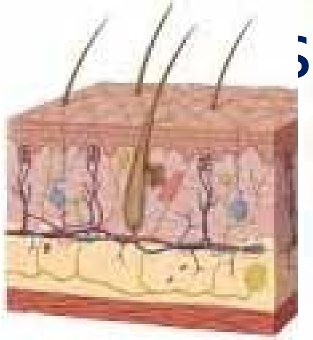


As with all the other Starling forces, normal interstitial pressure also varies among tissues.



In encapsulated organs, such as the kidney, normal interstitial pressures are positive.

As with all the other Starling forces, normal interstitial pressure also varies among [illegible]s.

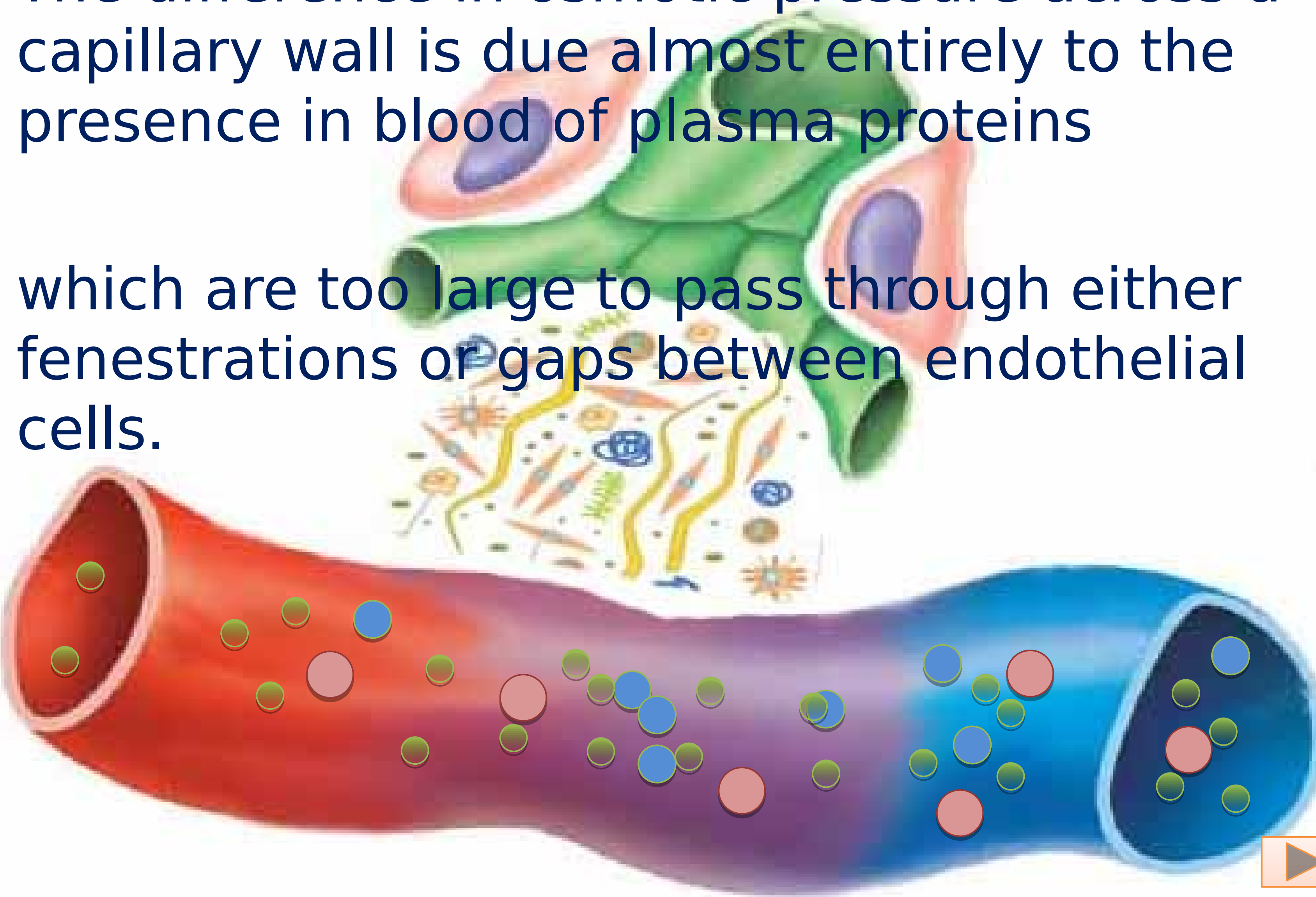


While in most of loose tissues like subcutenous layer in skin, this is subatmospheric.

Beside the mechanical and electrostatic properties of the tissue the continuous pumping of the lymph vessels also plays important role in the determination of the IFHP.

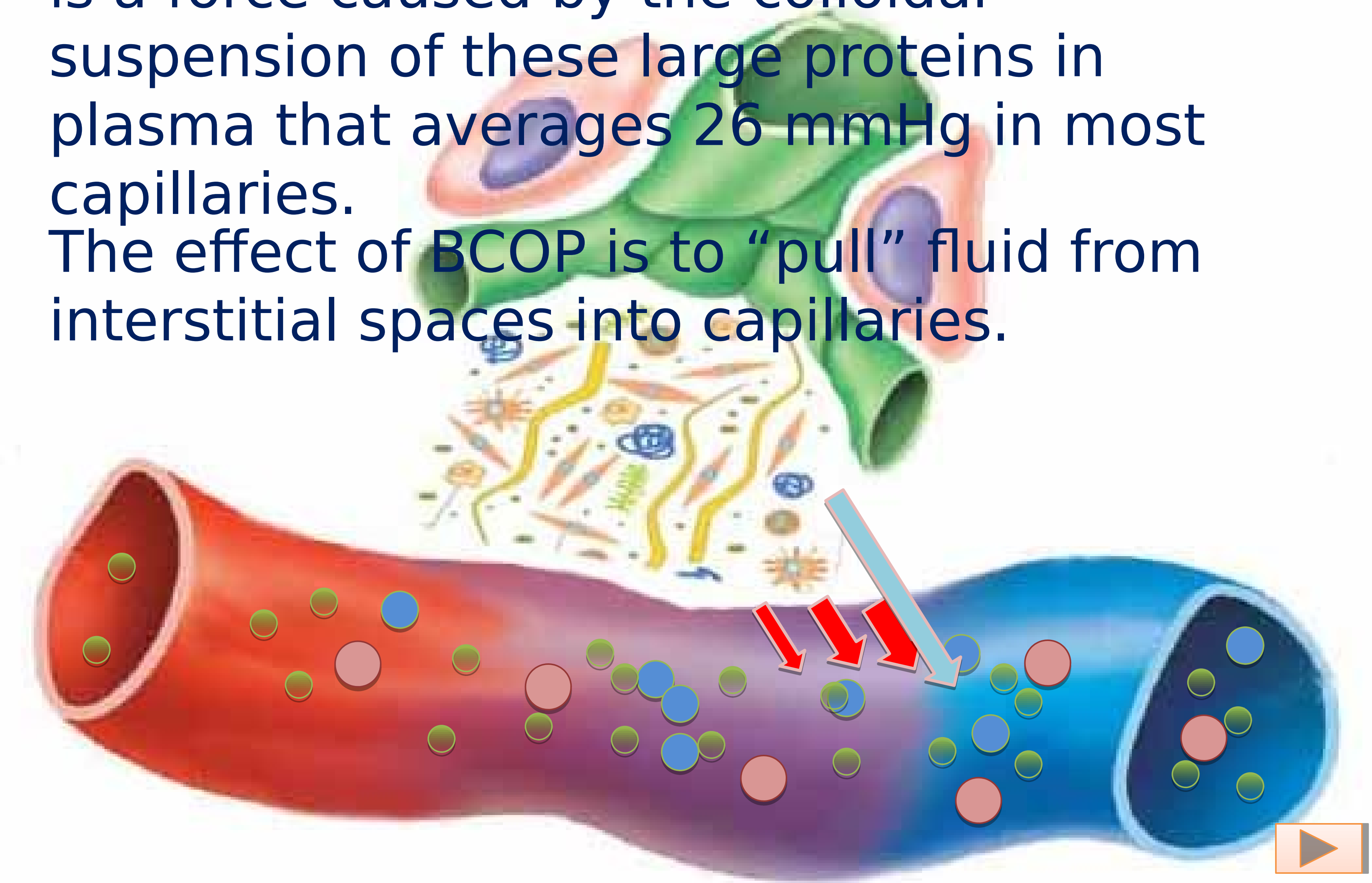
The difference in osmotic pressure across a capillary wall is due almost entirely to the presence in blood of plasma proteins

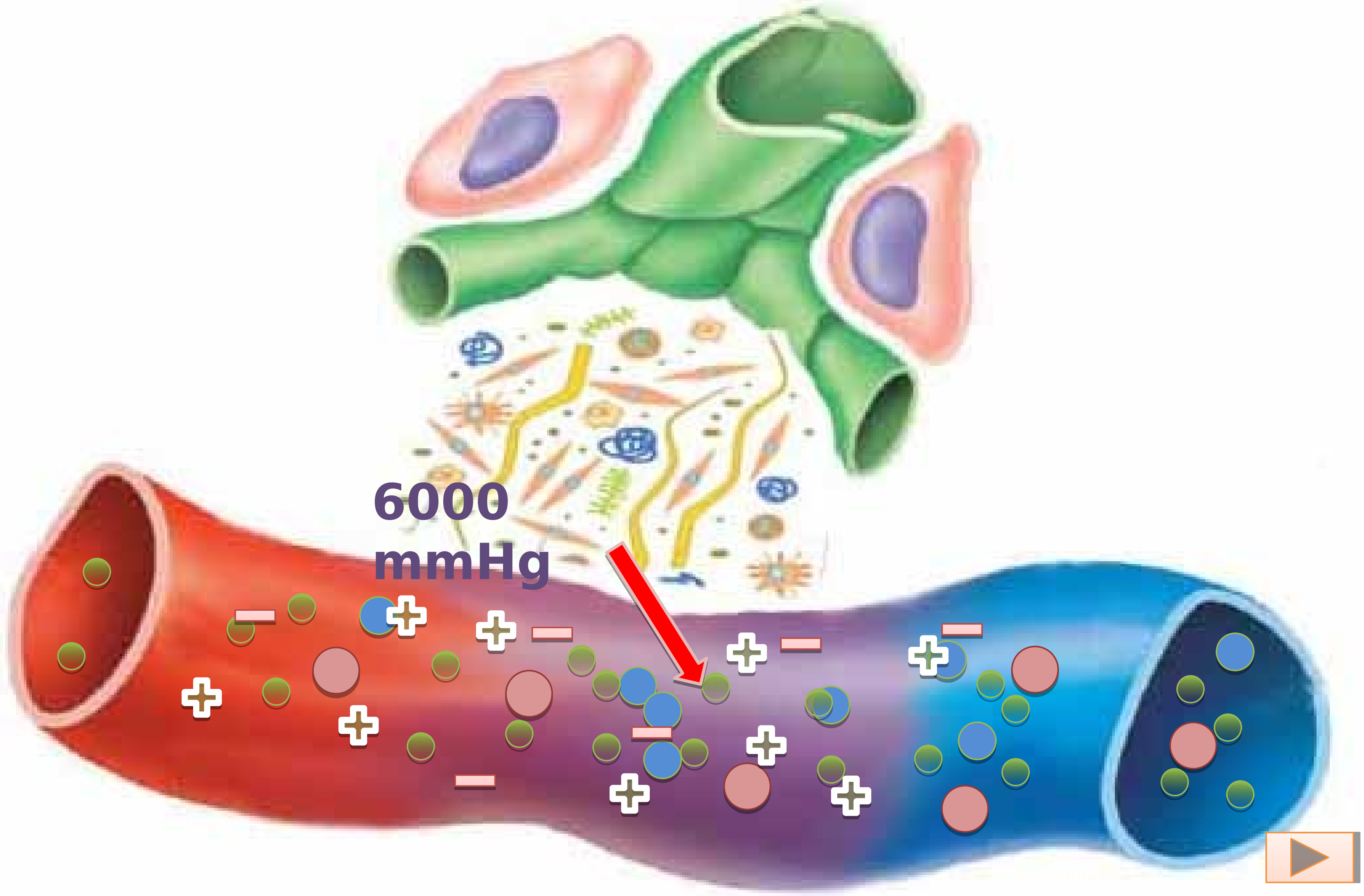
which are too large to pass through either fenestrations or gaps between endothelial cells.



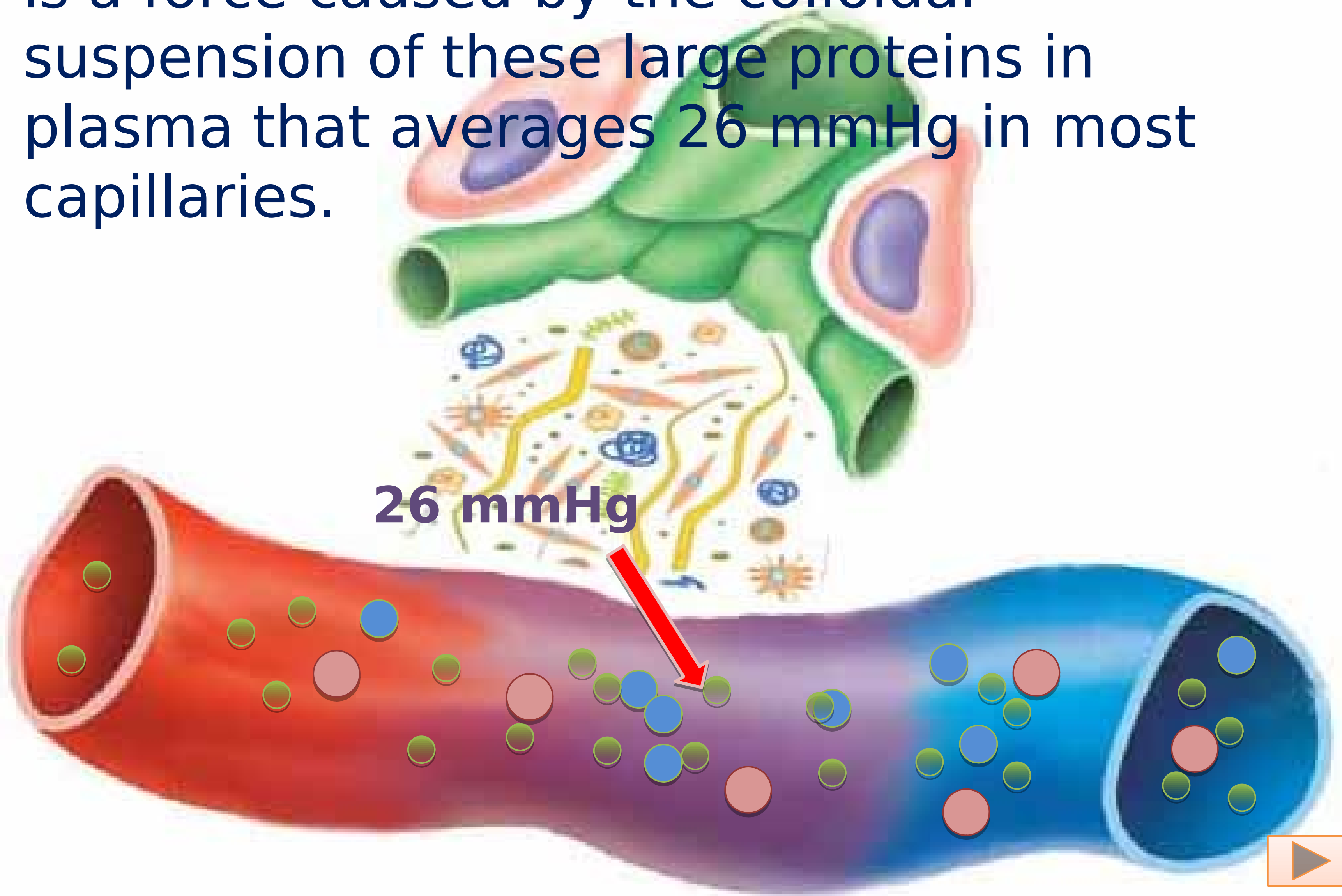
Blood colloid osmotic pressure (BCOP) is a force caused by the colloidal suspension of these large proteins in plasma that averages 26 mmHg in most capillaries.

The effect of BCOP is to “pull” fluid from interstitial spaces into capillaries.




6000
mmHg

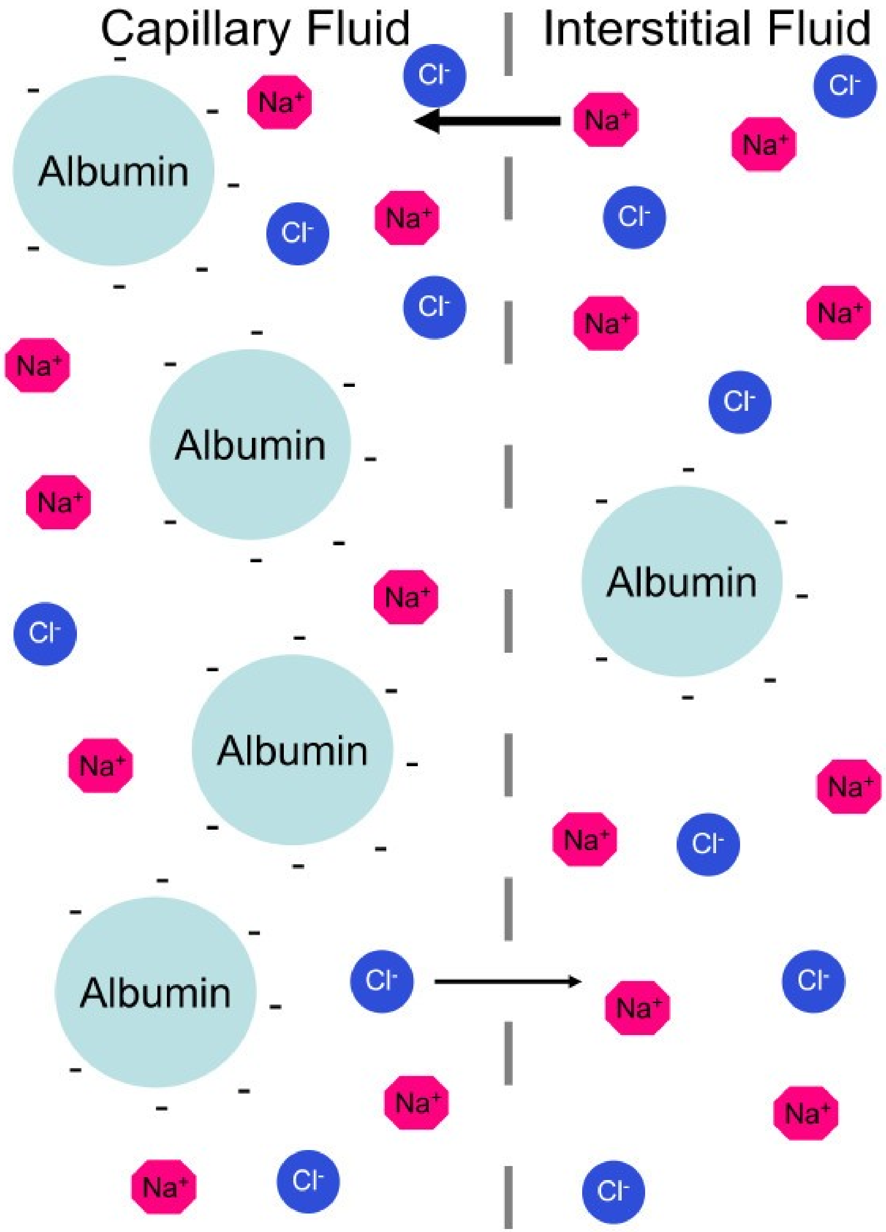
Blood colloid osmotic pressure (BCOP) is a force caused by the colloidal suspension of these large proteins in plasma that averages 26 mmHg in most capillaries.



Albumin is the primary plasma protein that is responsible for approximately 80% of the total BCOP.

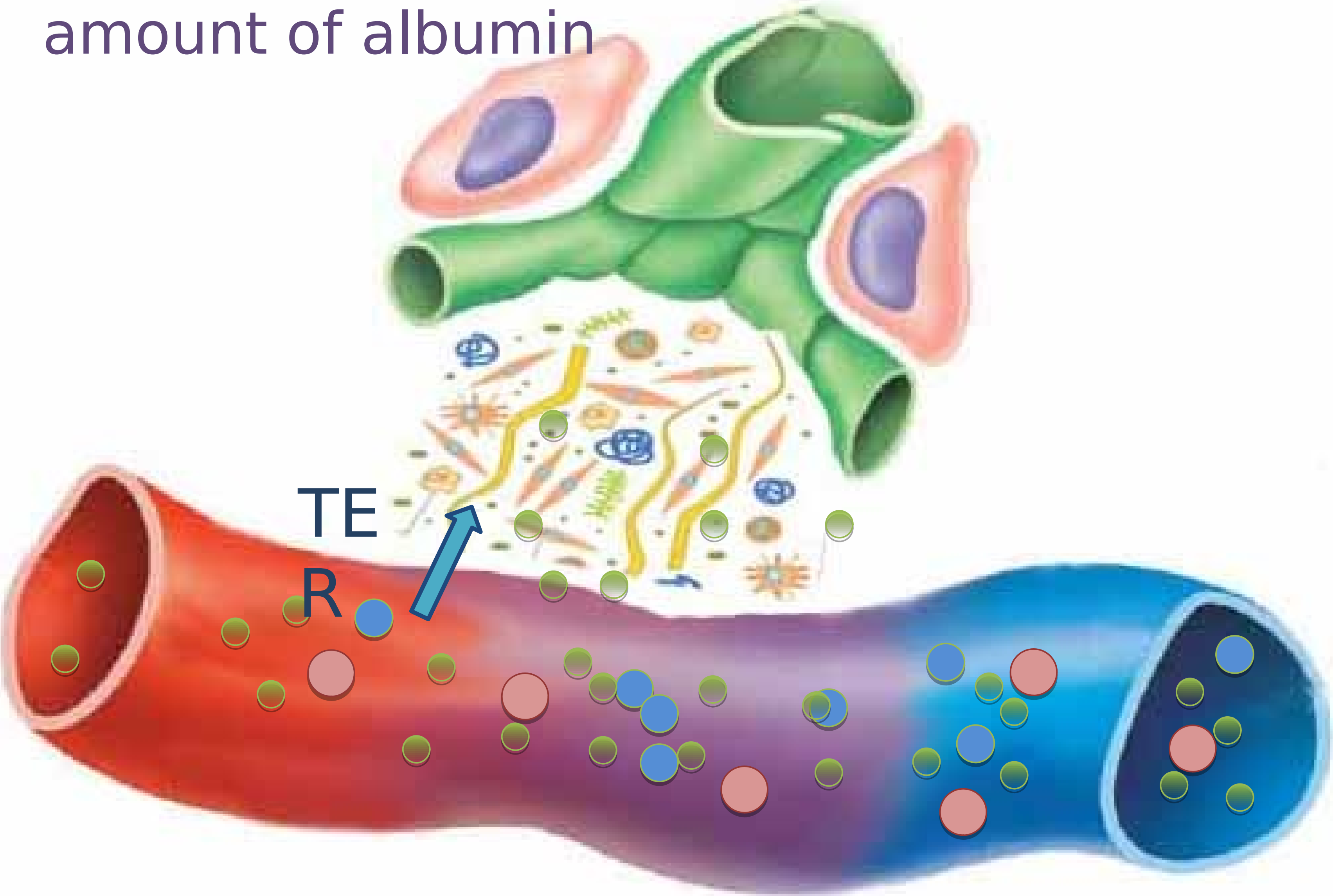
	g/dl	Πp (mm Hg)
Albumin	4.5	21.8
Globulins	2.5	6.0
Fibrinogen	0.3	0.2
Total	7.3	28.0

The charged characteristic of albumin plays an important role through its effect on osmotic pressure.



interstitial fluid osmotic pressure (IFOP), “pulls” fluid out of capillaries into interstitial fluid

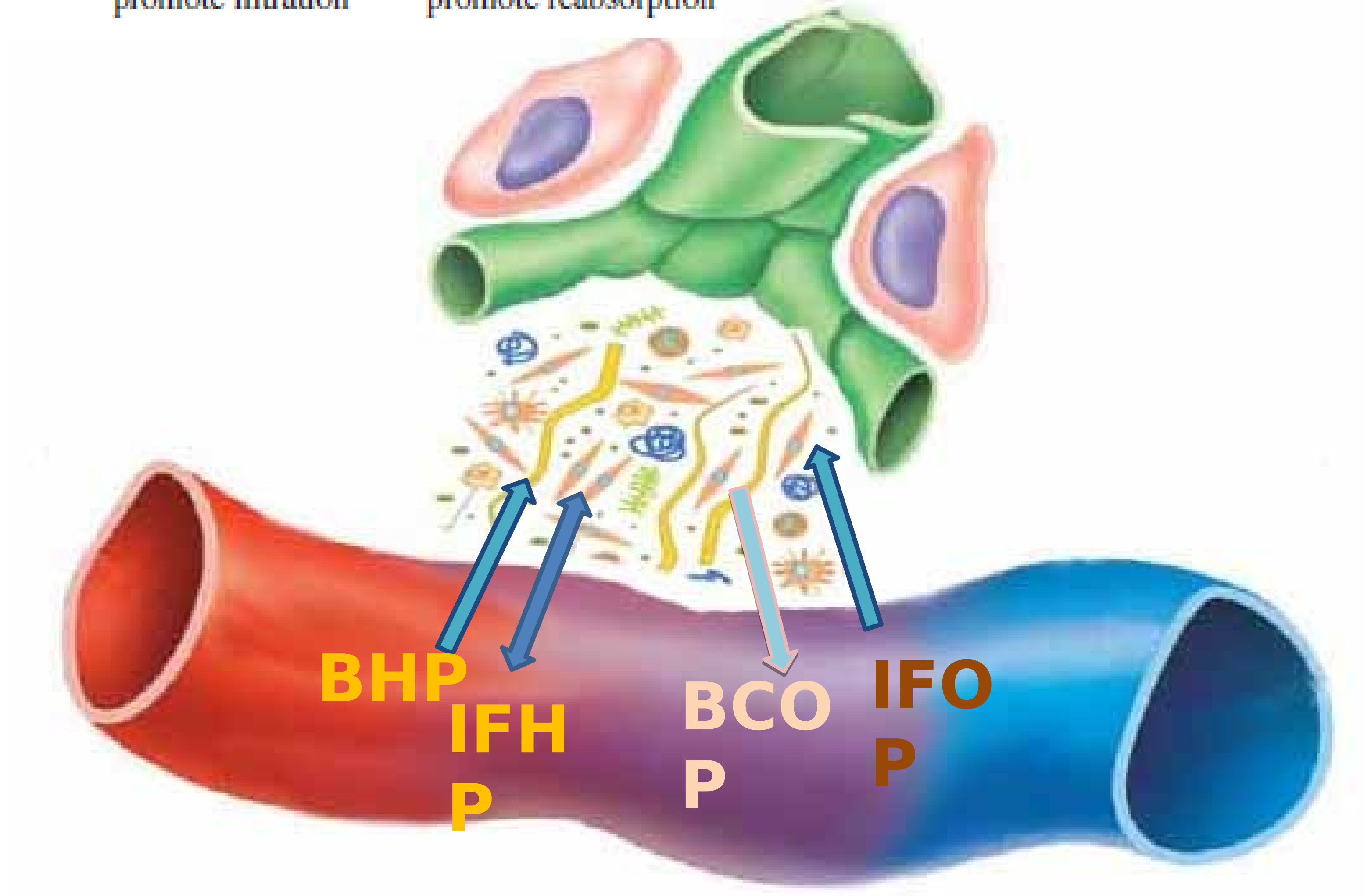
The interstitial fluid IFOP is generated from smaller size proteins and the minimal amount of albumin



$$NFP = (BHP + IFOP) - (BCOP + IFHP)$$

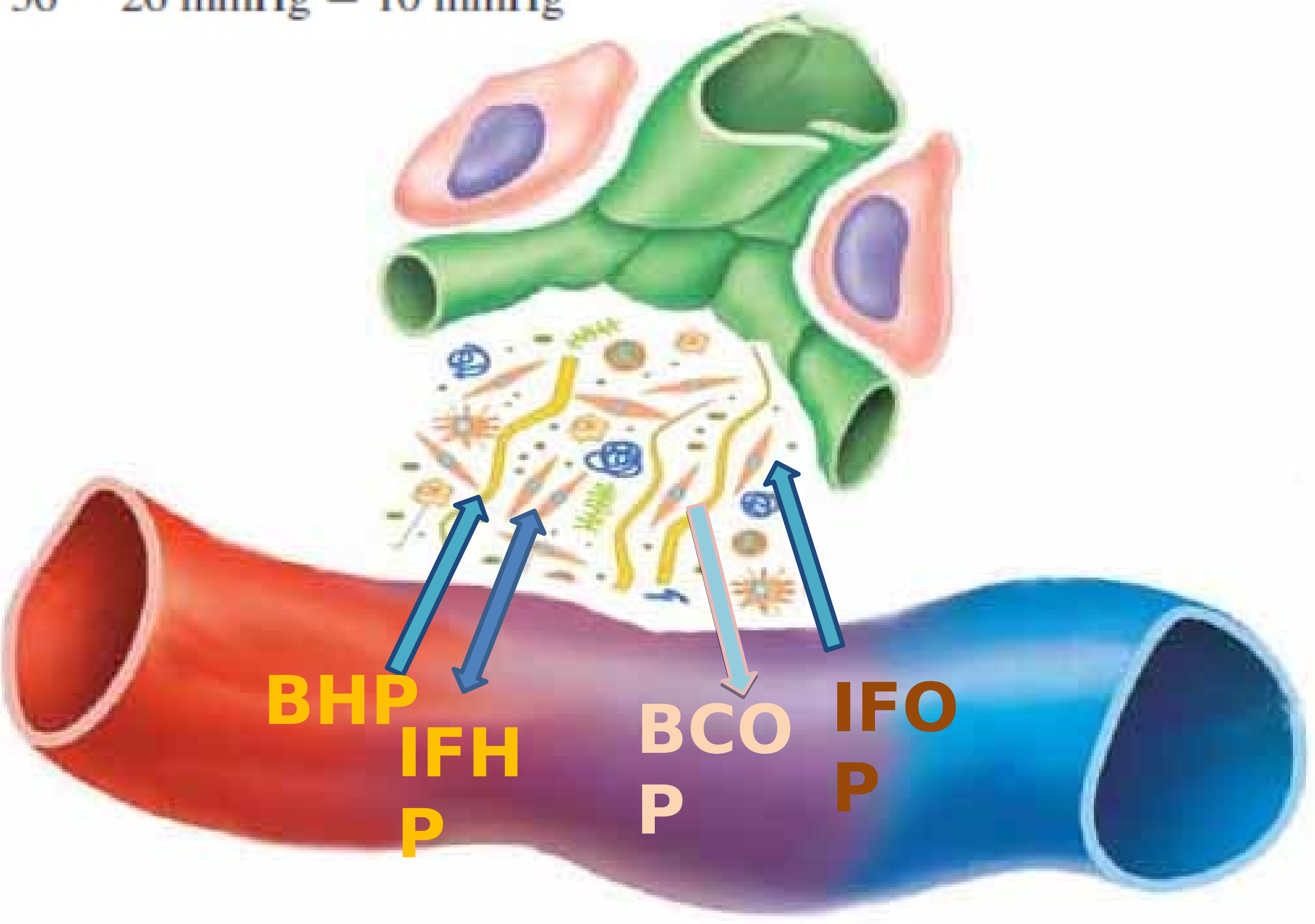
Pressures that promote filtration

Pressures that promote reabsorption



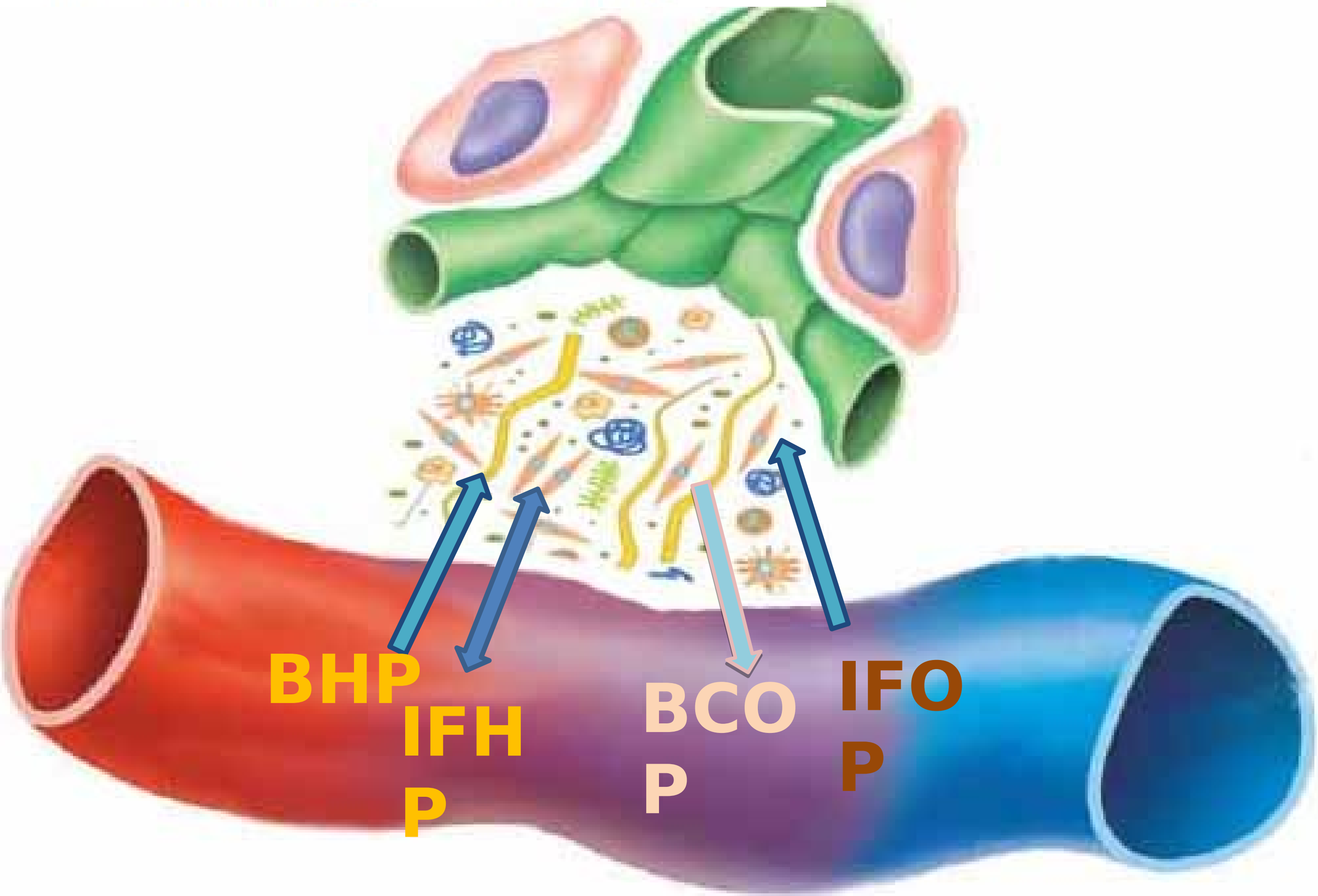
At the arterial end of a capillary

$$NFP = (35 + 1)\text{ mmHg} - (26 + 0)\text{ mmHg}$$
$$= 36 - 26\text{ mmHg} = 10\text{ mmHg}$$



At the venous end of a capillary

$$\begin{aligned} NFP &= (16 + 1)\ mmHg - (26 + 0)\ mmHg \\ &= 17 - 26\ mmHg = -9\ mmHg \end{aligned}$$



At the venous end of a capillary